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Koopman Control of Point Vortex Dynamics using Invariants KARTIK KRISHNA, ADITYA NAIR, EURIKA KAISER, STEVE BRUNTON, University of Washington, Seattle — We seek to manipulate the behaviour of a planar system of point vortices governed by the Biot-Savart law, which is often used to simulate fluid flows in an inviscid and incompressible setting. Inspired by recent advances in Koopman operator theory, we recast the original Biot-Savart law in terms of well known invariants of vortex dynamics (e.g. the Hamiltonian). This change of variables helps us obtain a linear representation of nonlinear dynamics and reduces the dimensionality for fluid flows, where the number of vortices is very large. We then leverage tools from control theory to manipulate vortex dynamics using virtual cylinders (vorticity generating actuators). In particular, we show that increasing (decreasing) the Hamiltonian enables the clustering (declustering) of multiple vortices. We are currently extending this work to dissipative flows for discrete vortex control.

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